

Enclosure 1: Summary to Support EPA's Decision

I. Introduction

The purpose of this review document is to describe the rationale for the Environmental Protection Agency's (EPA) partial approval and partial disapproval of Iowa's 2002 Clean Water Act (CWA) Section 303(d) List (list). The following discusses key elements of the State's submission based on the CWA and implementing regulations. EPA's review of Iowa's list is based on EPA's analysis of whether the State reasonably considered existing and readily available water quality related data and information.

A. Statutory and Regulatory Background

Section 303(d)(1) of the Act directs States to identify those waters within its jurisdiction for which effluent limitations required by Section 301(b)(1)(A) and (B) are not stringent enough to implement any applicable water quality standard, and to establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters. The Section 303(d) listing requirement applies to waters impaired by point and/or nonpoint sources, pursuant to EPA's long-standing interpretation of Section 303(d).

EPA regulations provide that States do not need to list waters where the following controls are adequate to implement applicable standards: (1) technology-based effluent limitations required by the Act, (2) more stringent effluent limitations required by State or local authority, and (3) other pollution control requirements required by State, local, or federal authority. See 40 CFR 130.7(b)(1).

B. Consideration of Existing and Readily Available Water Quality-Related Data and Information:

In developing Section 303(d) lists, States are required to assemble and evaluate all existing and readily available water quality related data and information, including, at a minimum, consideration of existing and readily available data and information about the following categories of waters:

- (1) Waters identified as partially meeting or not meeting designated uses, or as threatened, in the State's most recent Section 305(b) report.
- (2) Waters for which dilution calculations or predictive modeling indicate nonattainment of applicable standards.
- (3) Waters for which water quality problems have been reported by governmental agencies, members of the public, or academic institutions.

- (4) Waters identified as impaired or threatened in any Section 319 nonpoint assessment submitted to EPA (see 40 CFR 130.7(b)(5)).

In addition to these minimum categories, States are required to consider any other data and information that is existing and readily available. EPA's 1991 *Guidance for Water Quality-Based Decisions* describes categories of water quality related data and information that may be existing and readily available. See *Guidance for Water Quality-Based Decisions: The TMDL Process, EPA Office of Water, 1991, Appendix C* ("EPA's 1991 Guidance").

In addition to requiring States to assemble and evaluate all existing and readily available water quality-related data and information, EPA regulations at 40 CFR 130.7(b)(6) require States to include as part of their submissions to EPA, documentation to support decisions to rely or not to rely on particular data and information and decisions to list or not to list waters. Such documentation needs to include, at a minimum, the following information: (1) a description of the methodology used to develop the list, (2) a description of the data and information used to identify waters, and (3) any other reasonable information requested by the Region.

C. Priority Ranking

EPA regulations also codify and interpret the requirement in Section 303(d)(1)(A) of the Act that States establish a priority ranking for listed waters. The regulations at 40 CFR 130.7(b)(4) require States to prioritize waters on their Section 303(d) lists for TMDL development, and also to identify those water quality limited segments (WQLSs) targeted for TMDL development in the next two years. In prioritizing and targeting waters, States must, at a minimum, take into account the severity of the pollution and the uses to be made of such waters (*see* Section 303(d)(1)(A)). As long as these factors are taken into account, the Act provides that States establish priorities. States may consider other factors relevant to prioritizing waters for TMDL development, including immediate programmatic needs, vulnerability of particular waters as aquatic habitats, recreational, economic, and aesthetic importance of particular waters, degree of public interest and support, and State or national policies and priorities (*see* 57 FR 33040, 33045 [July 24, 1992], and EPA's 1991 Guidance).

II. Analysis of Iowa's 2002 Section 303(d) List

According to the State's "Listing Methodology," data sources used to assess water quality conditions in Iowa for purposes of Section 305(b) reporting and to aid in developing the State's 303(d) list include:

- (1) Physical, chemical, and biological data from fixed station water quality monitoring networks conducted by IDNR and other agencies.
- (2) Data from water quality monitoring conducted by adjacent states on border rivers and waters flowing into the state.

- (3) Data from biological monitoring being conducted by IDNR in cooperation with the University of Iowa Hygienic Laboratory (UHL) as part of a current effort to establish biological criteria for Iowa's ecoregions and subcoregions.
- (4) Data from the IDNR sponsored lake monitoring conducted by Iowa State University.
- (5) Data from monitoring of bacterial indicators in rivers and at beaches of publicly-owned lakes.
- (6) Data from programs to monitor fish tissue for toxic contaminants.
- (7) Reports of pollutant caused fish kills.
- (8) Data, when available, from public water supplies on the quality of raw and finished water.
- (9) Drinking water source water assessments under Section 1453 of the Safe Drinking Water Act.
- (10) Data from special studies of water quality and aquatic communities.
- (11) Best professional judgment of IDNR staff.
- (12) Results of volunteer monitoring (e.g., by IOWATER trained volunteers).
- (13) Water related information received from the public.

Additionally, sources of all existing and readily available water quality related data and information to be considered specifically for developing the State's 303(d) list include, but are not limited to, the following:

- (1) Iowa's most recent 305(b) report.
- (2) CWA Section 319 nonpoint source assessments.
- (3) Dilution calculations, trend analyses, or predictive models for determining the physical, chemical or biological integrity of streams, rivers, lakes, and estuaries.
- (4) Water quality related data and water related information from local, state, territorial, or federal agencies (especially the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA and National Stream Quality Accounting Network (NASQAN)), tribal governments, members of the public and academic institutions.

The State's submission letter explains that Iowa's 2002 list is composed of 5 parts. EPA is taking action only on the Parts which include WQLSs still requiring TMDLs. For the 2002 list, EPA action is required on Parts 1 and 5. EPA has reviewed Iowa's description of the data and information the State considered, its methodology for identifying waterbodies and Iowa's responses to public comment. In accordance with 40 CFR 130.7(d)(2), EPA is approving Parts 1 and 5, consisting of a total of 136 waterbodies, of Iowa's 2002 CWA Section 303(d) list. The following describes the five parts of the list:

Part 1 consists of 81 waterbody segments impaired by one or more pollutants for which TMDLs will be developed within the next 10-15 years. EPA is disapproving the states' failure to include 20 waterbodies on either Parts 1 or 5 of its list.

Part 2 consists of 58 waterbody segments for which no pollutant is causing the impairment. EPA is not taking action on this part of the list. EPA recognizes that States may include some WQLSs beyond those that are required by EPA regulations, such as waters where there is no pollutant associated with the impairment. However, neither the State nor EPA has an obligation under current EPA regulations to develop TMDLs for such waters because the waters are not impaired by a pollutant. States have the discretion under Section 303(d), which charges States with the primary responsibility to identify WQLSs for TMDL development, and Section 510, which authorizes States to adopt more stringent pollution controls, to include waters on their Section 303(d) lists that may not be required to be included by current EPA regulations. EPA's regulations do not compel the Agency to disapprove the State's list because of the inclusion of such waters. Iowa should consider scheduling these waters for monitoring to confirm that there continues to be no pollutant-caused impairment and to support appropriate water quality management actions to address the cause(s) of the impairment.

Part 3 consists of 27 waterbody segments for which EPA has already approved a TMDL.

Part 4 consists of 0 waterbody segments. Part 4 of the list is for waterbody segments that will attain water quality standards, as a result of implementation of technology-based effluent limitations required by the CWA or other controls enforceable by State law or regulations, prior to the submission of the next 303(d) list. Waterbodies included in Part 4 that do not achieve water quality standards by the next listing period may be moved to Part 1.

Part 5 consists of 55 waterbody segments identified as biologically impaired, but for which no identified cause of impairment has yet been identified. TMDLs are still required for these waters.

A. Nonpoint Sources

The State properly listed waters with nonpoint sources causing or expected to cause impairment, consistent with Section 303(d) and EPA guidance. Section 303(d) lists are to include all WQLSs still needing TMDLs, regardless of whether the source of the impairment is a point and/or nonpoint source. EPA's long-standing interpretation is that

Section 303(d) applies to waters impacted by point and/or nonpoint sources. In *Pronsolino v. Nastri*, the Ninth Circuit Court of Appeals held that section 303(d) of the CWA authorizes EPA to identify and establish TMDLs for waters impaired by nonpoint sources. *Pronsolino v. Nastri*, 291 F.3d. 1123 (9th Cir. 2002), cert. denied, 71 U.S.L.W. 3774 (U.S. June 16, 2003) (No. 02-1186). See also EPA's 1991 *Guidance and National Clarifying Guidance for 1998 Section 303(d) Lists*, Aug. 27, 1997.

B. Priority Ranking in Iowa's 303(d) List

Iowa's listing methodology describes how the State will prioritize waterbodies for purposes of establishing TMDLs. Iowa's 2002 303(d) list provided a priority ranking of each waterbody as required in Section 303(d)(1)(A) of the CWA and 40 CFR 130.7(b)(4) of EPA's implementing regulations.

A system of prioritization for waterbodies identified as "impaired" was developed by IDNR based on several factors. Included in these factors are the required elements of the severity of the pollution and the uses to be made of such waters. Other factors, such as best professional judgment of IDNR staff, results of volunteer monitoring, and public comments, may also be considered when prioritizing waters. Because a waterbody meets any one criteria in a priority category, does not necessarily mean the water will be prioritized in that category, since many waters fit some criteria from more than one category.

Priorities and Applicable Criteria

High

- Waters where sufficient water quality information exists to understand and analyze cause and effects of the problems and opportunities are available to correct or substantially improve water quality;
- Waters with imminent human health or aquatic health problems;
- Waters with documented widespread local support for water improvement; or
- Waters where state or federally threatened or endangered species are impacted.

Medium

- Waters where sufficient water quality information exists to understand and analyze cause and effects of the problems; however, opportunities are not immediately available to correct or substantially improve water quality; or
- Waters where local support for TMDL development is expected but not known.

Low

- Waters where insufficient water quality information exists to understand and analyze cause and effects of the problems and limited opportunities are available, at this time, to correct or substantially improve water quality; or
- Waters with no evident local support for water quality improvements.

C. Targeting

The consent decree resulting from consolidated case No. C98-134-MJM requires the establishment of TMDLs for 16 WQLSs by December 15, 2003, and TMDLs for 22 additional WQLSs by December 15, 2004.

D. Public Comment

Prior to putting out its public notice of the draft 2002 303(d) list, the IDNR developed a listing methodology. The first draft methodology was made available to a group of interested stakeholders on August 21, 2001. IDNR provided public notice of a revised methodology on April 3, 2002, through an IDNR press release, and accepted public comments on the revised methodology through May 17, 2002. A modification to Iowa's listing methodology addressing the use of the Trophic State Index to identify water quality impairments in Iowa lakes was presented at a stakeholders meeting on October 8, 2002. The final listing methodology is dated December 19, 2002.

IDNR published a Notice of Availability of its proposed Section 303(d) list of impaired waters on August 24, 2002, in the Des Moines Register. IDNR also provided notice of the availability of the proposed 2002 list to other statewide news organizations and to interest groups. Additionally, the proposed list was posted on IDNR's web site. IDNR accepted public comment through November 1, 2002. Subsequently, in response to public comments, IDNR prepared a responsiveness summary and submitted those responses to EPA for review as part of the 303(d) list submission.

E. Waterbody Segments Listed on Iowa's EPA Approved 1998 303(d) List, but not Included on Parts 1 or 5 the 2002 List

1. Waterbodies Removed with Good Cause

Federal regulations at 40 CFR 130.7(b)(6)(iv) require States, upon request by EPA, to demonstrate good cause for not including specific waterbodies on their 303(d) list. Good cause includes, but is not limited to, more recent or accurate data, more sophisticated water quality modeling, flaws in the original analysis that led to the water being listed, or changes in conditions. The State has demonstrated to EPA's satisfaction good cause for not including on the 2002 list a number of waterbodies which were on the EPA-approved 1998 list. Iowa has provided waterbody specific rationales to explain its reasoning for removing each waterbody from the State's list. EPA has reviewed each rationale and concluded that Iowa has provided good cause for removing the waterbodies identified in Enclosure 2 from its 2002 list.

2. Iowa Lakes Subject to Lake Study (Data Not Complete)

Currently, Iowa water quality standards do not provide specific numerical criteria for protecting the designated uses of Iowa waters, including lakes, from nutrients (nitrogen and phosphorus). Iowa water quality standards, however, do provide

use protection through narrative water quality standards. These include, but are not limited to, the following:

- (i) ...waters shall be free from materials attributable to wastewater discharges or agricultural practices producing objectionable color, odor, or other aesthetically objectionable conditions.
- (ii) ...waters shall be free from materials attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life.
- (iii) ...waters shall be free from materials attributable to wastewater discharges or agricultural practices, in quantities which would produce undesirable or nuisance aquatic life.

However, without numeric thresholds or translators or waterbody specific studies demonstrating use impairment, it is difficult to confidently and consistently assert which Iowa lakes are water quality limited.

According to IDNR, for purposes of identifying which waterbodies should be included on the state's 303(d) list, historical assessments of lake water quality in Iowa have been based primarily on the best professional judgment (BPJ) of IDNR fisheries biologists. Such BPJ may be supplemented with any (sometimes incomplete) monitoring data, which, according to the State's 2002 303(d) listing methodology, may not accurately reflect lake water quality. In 2000, Iowa began a five year lake water quality monitoring study through Iowa State University (ISU lake study) to obtain data that can be used to better characterize lake water quality.

According to Iowa's 2002 Section 303(d) listing methodology, at least three years of lake monitoring data from the ISU lake study will be used to identify water quality impairments appropriate for addition to Iowa's list. To account for the year to year variability in lake water quality, state limnologists recommend that the combined data from at least three years of monitoring be used. EPA agrees that a minimum of three years of data is preferred in order to accurately determine lake water quality. Three years of data will generally be more representative of normal trends, rather than unusual or extreme conditions.

During preparation of Iowa's 2002 list, however, data from only two years of the ISU lake study were available for consideration as existing and readily available water quality related data and information. Due to the lack of three years of data, the State identified interim thresholds for use in determining which Iowa lakes will be included on their 2002 303(d) list. The approach used by IDNR for developing numeric thresholds or translators for listing purposes is based on Carlson's (1977) Trophic State Index (TSI). Carlson's TSI is a numerical index for lakes developed by Dr. Robert Carlson, professor at Kent State University, Ohio. Carlson based his indices on plant biomass and used a numeric, continuous

scale, rather than a nomenclature approach. The TSI indices divide the continuous range of algal biomass based on a doubling of secchi depth, which is related to algal density and chlorophyll-a (USEPA, 2000). The index scale (0 to 100) represents biological productivity with each increase of ten units representing a doubling in algal biomass. In general, TSI values below 40 represent low production conditions (oligotrophic), the range between 40 and 50 represents moderately productive conditions (mesotrophic) and index values above 50 are associated with highly productive conditions (eutrophic). Values at 70 and above are associated with hypereutrophic lake conditions.

Iowa has included on its list those waters with TSI values for chlorophyll-a and/or Secchi depth greater than 70. Iowa's approach is based on the use of relatively high TSI thresholds to account for the lack of sufficient data the State believes is appropriate for accurately characterizing lake water quality. In the absence of the complete data set (three years) for lakes, Iowa feels that using these thresholds provides overwhelming evidence of water quality impacts and provides a high level of confidence that the lakes are impaired.

Iowa's approach has resulted in adding 28 lakes to the 2002 list. This approach has also resulted in the State removing 20 lakes from its 2002 list. EPA agrees with Iowa's decision to add the lakes the State has chosen to include on its 2002 list and is approving the inclusion of those lakes. It is unlikely that the third year of data collection will change the State's conclusion regarding impairment. The two years of data clearly indicate lakes in the eutrophic range; and, a third year of data is not likely to indicate a change of conditions. However, EPA does not believe it is appropriate at this time to remove lakes which are subject to the ISU lake study. Since the third year of lake study data is currently being analyzed by Iowa, EPA believes it is appropriate for Iowa to review the data and refine the numeric translators prior to removing study lakes from the 303(d) list. Therefore, EPA is disapproving Iowa's decision to remove from its list 20 lakes which are subject to the ISU lake study. EPA expects Iowa will complete its review of the third year of lake data and develops numeric translators for purposes of determining impairment in time to re-evaluate these lakes for the 2004 list.

EPA recognizes that the State is making an effort and moving forward to address questions of overall lake nutrient impairment in a more quantitative way. EPA supports the State's decision to conduct a lake study, collect three years of monitoring data, develop appropriate numeric translators for the purpose of determining which Iowa lakes are water quality limited and require TMDLs in accordance with Section 303(d) of the CWA and implementing regulations at 40 C.F.R. §130.7.

When developing the 2004 303(d) list, EPA expects Iowa to develop both a scientifically defensible approach and actual numeric translators or thresholds (including phosphorous) which can be used for purposes of determining which study lakes are water quality limited. Such translators should consider the three years of data from the ISU lake study as existing and readily available water

quality related data and information for purposes of identifying lakes and associated pollutants for inclusion on the 2004 303(d) list. If Iowa does not, EPA will review Iowa's efforts, develop numeric translators (including phosphorus) and determine which lakes will be included on Iowa's 2004 303(d) list. While reviewing Iowa's 2004 303(d) list and the ISU lake study data, EPA will also consider whether Iowa has appropriately identified all pollutants causing impairment of lakes included in the study (this includes lakes currently on Iowa's 2002 list).

The waterbodies, which EPA is adding back to Iowa's 2002 303(d) list are identified in Enclosure 3.

III. Consent Decree Commitments

On December 17, 2001, EPA entered into a consent decree in Sailors, Inc. and Mississippi River Revival v. U.S. EPA, and Sierra Club v. U.S. EPA, Case No. C98-134-MJM (N.D. Iowa). EPA committed in the consent decree to the following actions:

1. Transmit the following documents to Iowa for their consideration in developing the 2002 Section 303(d) list.
 - (i) The United States Geological Survey ("USGS") Technical Report 96-T005, "Rates of Sedimentation Along Selected Backwater Transects in Pools 4, 8, and 13 of the Upper Mississippi River" (October 1996)
 - (ii) USGS Report to Congress, "Ecological Status and Trends of the Upper Mississippi River System (1998)
 - (iii) Iowa DNR backwater sedimentation study of ten pools of the Mississippi, 1984 to present
 - (iv) Fate of Navigation Pool 19 on the Mississippi River, N.G. Bhowmik, USF&WS, 1993
 - (v) Sedimentation Rates and Standing Stock Estimates in Selected Sloughs of Pool 14 of the Mississippi River, T.I. Herbert, proceedings of the fifteenth annual meeting of the Mississippi River Research Consortium, 1984
 - (vi) Comprehensive Master Plan for the Management of the Upper Mississippi River System, Upper Mississippi River Basin Commission, 1982
 - (vii) United States Army Corps of Engineers Report to Congress, "An Evaluation of the Upper Mississippi River System Environmental Management Program" (December 1997)
2. Determine whether Iowa's 2002 Section 303(d) list includes Iowa WBID numbers:

IA 01-NEM-0040-2 (Pool 9: Lock and Dam #9 upstream to the Iowa/Minnesota state line)

IA 01-NEM-0040-1 (Pool 10: Wisconsin River upstream to Lock and Dam #9)

IA 01-NEM-0030-0 (Pools 10 and 11: Lock and Dam #11 at Dubuque upstream to

Wisconsin River)

IA 01-NEM-0020-2 (Pool 12: Catfish Creek upstream to Lock and Dam #11 at Dubuque)

IA 01-NEM-0020-1 (Pools 12 and 13: Lock and Dam #13 at Clinton upstream to Catfish Creek (near Dubuque))

IA 01-NEM-0010-4 (Pool 14: Wapsipinicon River upstream to Lock and Dam #13 at Clinton)

IA 01-NEM-0010-3 (Pool 14: Lock and Dam #14 upstream to Wapsipinicon River)

IA 01-NEM-0010-1 (Pools 16, 17 and 18: Iowa River upstream to Lock and Dam #15 at Davenport)

IA 02-ICM-0010-2 (Pools 18 and 19: Burlington Water Supply intake upstream to Iowa River)

IA 02-ICM-0010-1 (Pool 19: Skunk River upstream to Burlington Water Supply intake)

IA 03-SKM-0010-2 (Pool 19: Ft. Madison Waste Water Treatment Plant (“WWTP”) upstream to Skunk River)

IA 03-SKM-0010-1 (Pools 19 and 20: Iowa/Missouri state line upstream to outfall of Ft. Madison WWTP) (collectively, the “Pools” or the “Mississippi River Pools”)

If these waterbody segments are not on Iowa’s 2002 Section 303(d) list, EPA shall either:

- (1) Determine, in accordance with 40 C.F.R. §130.7(b), that any such Pool(s) need to be listed for sediment and/or turbidity, disapprove the omission of such Pool(s) for sediment and/or turbidity, and propose for public notice and comment an amendment that includes such Pool(s) for sediment and/or turbidity; or
 - (2) Determine, in accordance with 40 C.F.R. § 130.7(b), that such Pool(s) need not be listed for sediment and/or turbidity and approve the omission of such Pool(s) for sediment and/or turbidity.
3. Provide a waterbody-specific rationale justifying the omission of any such Pools for sediment and/or turbidity.

IDNR’s 2002 Section 303(d) list did not include any Mississippi River Pools listed above as impaired by sediment and/or turbidity. EPA has determined, in accordance with 40 C.F.R. §130.7(b), that these Pools do not need to be listed for sediment and/or turbidity and approves the omission of the Pools from Iowa’s 2002 303(d) list. The waterbody-specific rationale for this decision is provided in Attachment A.

EPA based its decision regarding the Pools of the Mississippi River identified below on Iowa's water quality standards applicable to sediment and turbidity. See Iowa Administrative Code §§ 61.2 and 61.3. Iowa segments the Mississippi River in its jurisdiction into three reaches for purposes of water quality standards. All three reaches are subject to Iowa's warm water aquatic life designated use and for primary contact recreation. IAC § 61.3(b). In addition, Iowa's general criteria apply to all surface waters in the State. IAC § 61.3(2).

EPA concluded that sediment and turbidity are not practical for purposes of determining impairment of Iowa's primary contact recreation use, since the Iowa WQS interpret that use with numeric criteria for only pH and fecal coliform. IAC § 61.3(3)(1). Therefore, EPA evaluated whether the data and information described below demonstrate that any of the Pools are failing to meet Iowa's general criteria. In particular, EPA considered the general criterion that requires waters to be "free from materials attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life." IAC § 61.3(2)(d).¹

Because Iowa has not developed a numeric criterion to interpret the narrative standard at § 61.3(2)(d), EPA evaluated the relevant data and information described below applying its best professional judgment to determine whether any of the data or information demonstrates that sediment or turbidity is resulting in adverse impacts on aquatic life such that the aquatic life standard is not met.² As described in more detail below, based on this evaluation EPA concludes that the information in the studies does not support a determination that the Pools are failing to meet the aquatic life standard. While some of the studies do provide information on rates of sedimentation in various Pools, none contain an analysis of the impact of such sedimentation on aquatic life.

The Mississippi River forms the State of Iowa's eastern border for approximately 300 miles and with eleven lock and dam structures forming pools varying in length from 10 to 47 miles in length (IHL, 1970). The area under review for this assessment includes Mississippi River Pools 9, 10, 11, 12, 13, 14, 16, 17, 18, 19 and 20. The State of Iowa designates the Mississippi River for purposes of its surface water quality standards into three reaches. The northernmost of these three reaches flows from the northern border of Iowa to the confluence of the Iowa River (includes a portion of Pool 9, Pools 10 - 17 and a portion of Pool 18); the middle reach from the Iowa River to the confluence of the Skunk river (includes portions Pools 18 and 19); and the

¹ The other general criteria are not applicable from a practical standpoint to sediment or turbidity. The first criterion applies to substances attributable to point source wastewater discharges which settle to form sludge deposits. The second criterion applies to floating materials, oil, grease, and scum. The third criterion applies to materials that produce aesthetically objectionable conditions. The fifth criterion applies to materials that produce undesirable or nuisance aquatic life, and the final criterion applies only to point source discharges. IAC § 61.3(2).

² Iowa's WQS provide that application of narrative standards without numeric limitations will be based on certain EPA guidance documents. IAC § 61.2(1). However, these guidance documents do not provide a practical mechanism for developing numeric criteria for sediment or turbidity.

southern reach from the Skunk River to the southern border (includes portions of Pools 19 and 20).

The term sediment refers to “clean” sediment whose impact on the aquatic community is not associated with chemical toxicity. Sediment is generally measured in milligrams per liter (mg/l). The term turbidity refers to a measure of water clarity, or conversely, the loss of water transparency that results from the scattering of light by suspended solids (USGS, 1999). For purposes of determining impairment due to sediment and/or turbidity for the Mississippi River bordering Iowa, EPA relied on Iowa’s water quality standards as specified in the December 17, 2001 consent decree. Currently, these standards are established under Iowa Code Section 455B.171 and set forth at Iowa Administrative Code Section 61.2 - 61.3. The state water quality standard for turbidity located at 61.3(2)(f) states “The turbidity of the receiving water shall not be increased by more than 25 Nephelometric turbidity units by any point source discharge”. Iowa water quality standards do not provide a sediment specific criterion. However, in order to fulfill the consent decree requirement, in the absence of a sediment criterion, EPA considered Iowa’s general water quality criteria. Section 61.3(2), general water quality criteria, provides among other things that “waters shall be free from materials attributable to wastewater discharges or agricultural practices in concentrations or combinations which are acutely toxic to human, animal, or plant life.” According to Iowa’s administrative code, general water criteria applies to all surface waters to protect livestock and wildlife watering, aquatic life, noncontact recreation, crop irrigation, and industrial, domestic, agricultural and other incidental water withdrawal uses not protected by the specific numerical criteria of subrule 61.3(3). Unlike for turbidity, however, Iowa does not have numeric translators for this general criteria which could be used for purposes of determining water quality impairment. Therefore, EPA reviewed reports, documents and other existing and readily available water quality information to determine whether, considering this general criteria, aquatic life in the Mississippi River is impaired by the pollutant sediment.

After a thorough review of the documentation provided, a clear data linkage between sediment and/or turbidity and impairment of aquatic life in the State of Iowa’s stretch of the Mississippi River is lacking. Although a number of studies regarding sediment and turbidity have been conducted on the Mississippi River, the studies presented in the list of documents reviewed did not contain data with statistically significant correlations relating sediment and/or turbidity to impacts to aquatic life in the State of Iowa’s stretch of the Mississippi River. Information linking sediment and/or turbidity with the impairment of aquatic life on the Iowa side of the Mississippi River in the documents reviewed was largely qualitative and anecdotal. Study observations were varied and inconclusive. See Attachment A for Mississippi River pool numbers covered in documents reviewed.

Studies Specified in the Consent Decree with SAILORS, Inc., Mississippi River Revival And Sierra Club

Hiebert et al., in a 1982 study, (reference Attachment B(v)) , indicated an ‘apparent correlation’ between sedimentation rates (measured as depth) and standing stock estimates of fish (measured in kg/ha) in selected sloughs in Pool 14. The authors predicted further decline in standing stock in slough habitats if sedimentation continues. No other studies corroborated these findings from the 20 year-old study.

Rogala and Boma (USGS; 1996), (reference Attachment B (i)), found a high degree of variability in sediment accumulation rates among Pools 4, 8 and 13 over the seven year study period of 1989 to 1996. Mean accumulation rates measured in their study were lower than other accumulation rates previously documented which may have been a reflection of real changes in rates over time or possibly natural variability. The authors stated that it was not appropriate to make long-term estimates of the operational longevity of backwaters due to the within pools variability that they observed.

Using data collected under the Environmental Management Program's Long Term Resource Monitoring Program (LTRMP), the U.S. Geological Survey reported in Ecological Status & Trends of the Upper Mississippi River System (1998), (reference Attachment B (ii)), that turbidity and suspended solids may have affected the abundance of aquatic plants in the Upper Mississippi River System (UMRS). Submersed aquatic plants declined sharply in much of the UMRS during the 1980's possibly due to nutrients, phytoplankton and light availability.

Re-establishment of the aquatic vegetation may have been hindered by limited light availability. The authors go on to state, however, that the Upper Impoundment Reach backwaters of the UMRS generally have good sediment quality. Some backwater areas in the headwaters of the impoundments are affected by high sediment loads from tributaries and island erosion but submerged aquatic vegetation is most abundant in the upper impoundment reaches of Pools 4 to 13. No consistent long-term trend of increasing turbidity across the entire UMR system is documented in the LTRMP data included in these publications. Turbidity and suspended solids *may* have affected the abundance of aquatic plants in certain reaches of the river, but there is no documented correlation between turbidity or suspended solids and aquatic plant abundance in the publications reviewed.

Bhowmik et al., (1993), (reference Attachment B (iv)), predicted in their study of Pool 19 that Montrose Flats, a highly biologically productive area with "extensive beds of macrophytes and invertebrates" may in time become a mudflat with macrophyte beds transitioning into terrestrial systems. Likewise, in a 1982 document from the Upper Mississippi River Basin Commission, (reference Attachment B (vi)), the authors stated that "research and planning efforts indicate that within the next 50 years many ecologically rich backwaters and side channels will be eliminated or severely degraded due to sedimentation." In the Report to Congress - An Evaluation of the Upper Mississippi River System Environmental Management Plan (1997), (reference Attachment B (vii)) the authors state that "sedimentation will continue to degrade the quantity and quality of non-channel habitats." The authors predicted that continued sedimentation of aging pools will yield higher turbidity levels, reductions in submerged aquatic plants and benthic invertebrates and shifts in fish species community composition. Aspelemeier and Griffin, (reference Attachment B (iii)), in an Iowa Department of Natural Resources PowerPoint presentation, presented average sedimentation rates in pools 9 - 14 and pools 16 - 19. However, quantitative data linking sedimentation with measurable aquatic life impairment were not provided in the aforementioned reports.

Current and conclusive evidence as to impairment of aquatic life from sediment or turbidity was not found in the documents reviewed. Impairment to aquatic life from sediments or turbidity may exist in the Mississippi River within the State of Iowa, however, sufficient quantitative data and a weight of evidence among the documents/studies to conclusively determine impairment of

aquatic life from sediments or turbidity was not found within the documents reviewed.

Additional Studies Reviewed

In addition to reviewing the materials specified in the consent decree, EPA conducted a search to identify other existing and readily available water quality related data and information for purposes of determining compliance of the Mississippi River with Iowa sediment and turbidity water quality standards. As a result, numerous other studies, papers and documents were identified and reviewed. These materials are also listed, along with documents referred to in the consent decree in Attachment B. A review of selected studies is provided below.

Sauer (1998) concluded that ammonia may have been a partial cause in the decline of the fingernail clam. Wilson et al. (1995) “hypothesized” that decreases in fingernail clam populations were possibly due to point source pollution (Pools 2-8) and drought conditions (Pool 19). In a rather dated study, the Iowa Hygienic Laboratory (1969a) found “significant bacteriological and biological deterioration” below waste water discharges below Davenport and recommended corrective actions and further study. The Hygienic Laboratory also found dissolved oxygen violations below Ft. Madison primarily due to sewage and paper mill discharges (1969b). The authors of a second Iowa Hygienic Laboratory (1970) report found degraded benthic communities, fecal contamination and slime bacterial growth downstream of five cities and recommended additional treatment of municipal wastes. However, the authors found water quality, in general, to be excellent with the exception of extensive algal blooms at various times. These studies documented localized water quality problems likely attributable to specific point source discharges and, if these problems did include issues associated with water clarity or turbidity, were caused by nutrient enrichment rather than solids or sedimentation. There should be some consideration of the age of these studies as well in using them to make determinations of current water quality impairment.

Gutreuter et al.(1997) found 127 species of fish during 5 years of sampling. The study area included Pools 4, 8, 13, 26 and open river miles 29 - 80 on the Mississippi River and the La Grange Pool of the Illinois River. This measure of species abundance approaches the 150 species identified since recording began in the late 19th century. Gutreuter et al. concluded that there was no evidence of a decline in fish richness or biodiversity from 1990 to 1994 nor since that time period and that the Upper Mississippi River System has been “remarkably stable in its biodiversity” (fish diversity).

Gaugush (1997) studied sediment loads, output and estimated input in Pool 13 and the La Grange pool on the Illinois River. Preliminary results suggested that ‘while Pool 13 may be very near an equilibrium state with respect to its sediment load, the La Grange Pool appears to be trapping a significant portion of its sediment load’. In a dated study, Gakstatter (1970), survey the Mississippi below six municipal treatment plants and summarized his findings as ‘in general, the Iowa reach of the Mississippi River contains water of excellent quality...compared to streams within the borders of the state, the Mississippi waters are relatively low in dissolved materials and nutrients although at times extensive algal population are present’. In another rather dated study, Grove et. al. (1982), found silt decreasing depth in lower reaches of pool 19, thus increasing size and distribution of aquatic plant beds. Macroinvertebrate community differences were found ‘in relation to plant bed structure with little overlap between the communities.

Canfield et al., (1998) using the sediment triad approach (laboratory toxicity test, sediment chemistry & benthic community analysis) reported that 88% of the sediment samples examined were determined to be not impaired based on the triad measures. Wilson et al., (1995) found declining populations of fingernail clams (*Musculium transversum*) in pools 2, 5, 7, 9 and 19. Pool 19 had nearly no specimens. Wilson et al., cited toxic contaminations in sediments from point sources as possible causes of impairment. Pool 19 may have been impaired from low flow conditions and accumulated sediments and associated toxics. These studies focused predominantly on toxicity resulting from contamination and contaminated sediments.

Vohs (1993) stated that the Mississippi River is considered a clear water river until it joins with the Missouri River. Rogala et al., (1997), authors of a Corps of Engineers report on rates of net fine sediment accumulation found rates ranged from 0.017 to 1.36 cm/year. Net fine sediment accumulation in backwaters ranged from 0 to 0.82 cm/year. Overall means were 0.29 cm/year with 0.43 cm/year for small low-connected backwaters and 0.57 cm/year for large backwaters. No correlations to biological impairment were provided.

In conclusion, the additional studies reviewed (studies in addition to the documents specified in the consent decree) did not provide a clear data linkage between sediment (narrative criterion) and/or turbidity (numeric criterion) and impairment of aquatic life in the State of Iowa's stretch of the Mississippi River. Again, impairment to aquatic life from sediments or turbidity may exist in the Mississippi River within the State of Iowa, however, sufficient quantitative data and a weight of evidence among the documents/studies to conclusively determine impairment of aquatic life from sediments or turbidity was not found within the documents reviewed.

**Attachment A: Rationale For Not Including Segments of the Mississippi River on Iowa's
2002 303(d) List for Sediment and/or Turbidity**

Pool	Title & Author	Conclusion
Pool 9	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 9	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. "Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 10	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 10	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. "Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach, 88% of sediment (contaminated sediment) samples not impaired
Pool 10	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium. No evidence of the pollutant sediment causing impairment
Pool 11	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 11	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. "Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 11	State Hygienic Laboratory: "Water Quality Survey Mississippi River Dubuque, IA (1971)	Not listed because study documented water quality problems were caused by specific point source discharges. Water clarity problems caused by nutrient enrichment

Pool 11	State Hygienic Laboratory: "Water Quality Survey Mississippi River Dubuque, IA (1971)	Not listed. Impairments due to need for better controls on municipal discharges
Pool 11	U.S. Geological Survey. 1999. "Ecological status and trends of the Upper Mississippi River System 1998".	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 11	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium
Pool 12	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 12	UPPER MISSISSIPPI RIVER BASIN COMMISSION: "Comprehensive Master Plan for the Management of the Upper Mississippi River System" (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 12	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. "Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 12	State Hygienic Laboratory: "Water Quality Survey Mississippi River Dubuque, IA (1971)	Not listed because study documented water quality problems were caused by specific point source discharges. Water clarity problems caused by nutrient enrichment
Pool 12	U.S. Geological Survey. 1999 "Ecological status and trends of the Upper Mississippi River System 1998".	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 12	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium

Pool 13	U.S. Geological Survey: “Rates of Sedimentation Along Selected Backwater Transects in Pools 4, 8, and 13 of the Upper Mississippi River “ (1996)	Not listed because mean accumulation rates of sediment were lower than previously documented which could have been a reflection of real changes or natural variability. Not appropriate to make long term estimates due to within pools variability observed
Pool 13	IDNR: Aspelmeier, Bill and Griffin, Mike “Sediment Study UMRS”. Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 13	Upper Mississippi River Basin Commission: “Comprehensive Master Plan for the Management of the Upper Mississippi River System” (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 13	U.S. Army Corp of Engineers “Report to Congress - An evaluation of the Upper Mississippi River System Environmental Management Program” (1997)	Not listed because conclusion was not based on linking measurable aquatic life impairment to sedimentation
Pool 13	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. “Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 13	Gakstatter, J.H. and Morris, R.L. “Limnology of the Iowa Reach of the Mississippi River.” (1970)	Gakstatter summarized his findings as ‘in general, the Iowa reach of the Mississippi River contains water of excellent quality... the Mississippi waters are relatively low in dissolved materials and nutrients although at times extensive algal population are present’.
Pool 13	Gaugush, Robert F. “Sediment Budgets for Two Navigation Pools of the Upper Mississippi River System” (1997)	Preliminary results suggested that ‘while Pool 13 may be very near an equilibrium state with respect to its sediment load, the La Grange Pool appears to be trapping a significant portion of its sediment load’.
Pool 13	Gutreuter, S. “Fish monitoring by the Long Term Resource Monitoring Program on the Upper Mississippi River System” (1997)	Not listed because no evidence of a decline in fish species diversity during study period 1990-1994
Pool 13	Sauer, J.S. “Temporal Analyses of Select Macroinvertebrates in the Upper Mississippi River System” (1998)	Not listed because concluded ammonia was cause of decline of fingernail clam

Pool 13	U.S. Geological Survey. 1999. "Ecological status and trends of the Upper Mississippi River System 1998".	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 13	Vohs, P.A., Moore, J.J. and Ramsey, J.S. "A Critical Review of the Effects of Turbidity on Aquatic Organisms in Large Rivers." (1993)	Not listed because author concluded Mississippi River considered a clear water river until joined by Missouri River at St. Louis, Missouri
Pool 13	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium. No evidence of the pollutant sediment causing impairment
Pool 14	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 14	Hiebert, T.I., Bernhard, P.H. Howe, and Helms, D.R. "Sedimentation Rates and Standing Stock Estimates in Selected Sloughs of Pool 14 of the Mississippi River: Mississippi River Research Consortium." (1982)	Not listed because of age of study with no other study corroborating conclusion
Pool 14	Upper Mississippi River Basin Commission: "Comprehensive Master Plan for the Management of the Upper Mississippi River System" (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 14	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. "Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 14	Gakstatter, J.H. and Morris, R.L. "Limnology of the Iowa Reach of the Mississippi River." (1970)	Gakstatter summarized his findings as 'in general, the Iowa reach of the Mississippi River contains water of excellent quality... the Mississippi waters are relatively low in dissolved materials and nutrients although at times extensive algal population are present'.

Pool 14	U.S. Geological Survey. 1999. "Ecological status and trends of the Upper Mississippi River System 1998".	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 14	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium. No evidence of pollutant sediment causing impairment
Pool 14	Wilson, D.M., Naimo, T.J., Wiener, J.G., Anderson, R.V., Sandheinrich, M.B. and Sparks, R.E. "Declining Populations of the Fingernail Clam Musculium Transversum in the Upper Mississippi River Hydrobiologia (1995)	Not listed because no conclusions were drawn from Pool 14 data
Pool 16	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 16	Upper Mississippi River Basin Commission: "Comprehensive Master Plan for the Management of the Upper Mississippi River System" (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 16	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. "Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 16	Gakstatter, J.H. and Morris, R.L. "Limnology of the Iowa Reach	Gakstatter summarized his findings as 'in general, the Iowa reach of the Mississippi River contains water of excellent quality... the Mississippi waters are relatively low in dissolved materials and nutrients although at times extensive algal population are present'.
Pool 16	Lugn, A.L. "Sedimentation in the Mississippi River between Davenport, Iowa and Cairo, Illinois (1927)	Ph.D. dissertation published in 1927. Six types of classes (size & percent) of sediment were identified in the Miss. River between Davenport, IA. and Cairo, Illinois.
Pool 16	Iowa Hygienic Laboratory "Mississippi River Water Quality Survey Report" (1969)	Not Listed because impairment appeared to be caused by point source discharges

Pool 16	U.S. Geological Survey. 1999. "Ecological status and trends of the Upper Mississippi River System 1998".	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 16	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium. No evidence of pollutant sediment causing impairment
Pool 17	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 17	Gakstatter, J.H. and Morris, R.L. "Limnology of the Iowa Reach	Gakstatter summarized his findings as 'in general, the Iowa reach of the Mississippi River contains water of excellent quality... the Mississippi waters are relatively low in dissolved materials and nutrients although at times extensive algal population are present'.
Pool 17	Upper Mississippi River Basin Commission: "Comprehensive Master Plan for the Management of the Upper Mississippi River System" (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 17	Lugn, A.L. "Sedimentation in the Mississippi River between Davenport, Iowa and Cairo, Illinois (1927)	Ph.D. dissertation published in 1927. Six types of classes (size & percent) of sediment were identified in the Miss. River between Davenport, IA. and Cairo, Illinois.
Pool 17	U.S. Geological Survey. 1999. "Ecological status and trends of the Upper Mississippi River System 1998".	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 17	Wiener, James, Anderson, Richard, McConville, David (Contaminants in the Upper Mississippi River. (1984)	Book - Proceedings of annual meeting (1982) of the Miss. River Research Consortium. No evidence of pollutant sediment causing impairment
Pool 18	IDNR: Aspelmeier, Bill and Griffin, Mike "Sediment Study UMRS". Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment

Pool 18	Upper Mississippi River Basin Commission: “Comprehensive Master Plan for the Management of the Upper Mississippi River System” (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 18	Lugn, A.L. “Sedimentation in the Mississippi River between Davenport, Iowa and Cairo, Illinois (1927)	Ph.D. dissertation published in 1927. Six types of classes (size & percent) of sediment were identified in the Miss. River between Davenport, IA. and Cairo, Illinois.
Pool 18	MBUR (Mississippi at Burlington) “Daily Concentration, Load and Flow” (2000)	No conclusion
Pool 18	U.S. Geological Survey. 1999. “Ecological status and trends of the Upper Mississippi River System 1998”.	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 19	IDNR: Aspelmeier, Bill and Griffin, Mike “Sediment Study UMRS”. Power Point Presentation (no date)	Not listed because no quantitative data linkage between sedimentation and measurable aquatic life impairment
Pool 19	Bhowmik, Nani G., Adams, J. Rodger and Sparks, Richard E. “Fate of Navigation Pool on Mississippi River. (1993)	Not listed because conclusion was a prediction
Pool 19	Upper Mississippi River Basin Commission: “Comprehensive Master Plan for the Management of the Upper Mississippi River System” (1982)	Not listed because conclusion was a future prediction on effects of sedimentation
Pool 19	U.. Army Corp of Engineers, Report to Congress, “An Evaluation of the Upper Mississippi River system Environmental Management Program” (1997)	Not listed because conclusion was not based on linking measurable aquatic life impairment to sedimentation
Pool 19	Canfield, T.J. , Brunson, E.L., Dwyer, F.J., Ingersoll, C.J., Kemble, N.E. “Assessing Sediments from Upper Mississippi River Navigational Pools Using a Benthic Invertebrate Community Evaluation and Student Quality Triad Approach (1998)	Not listed because use of sediment triad approach reported, 88% of sediment (contaminated sediment) samples not impaired
Pool 19	Cole, Bill, FAX: “Turbidity data from 1998 to Current from Keokuk, Iowa (2001)	Not listed because average daily turbidity readings from 1/1/98 to 10/07/01 are low to moderate turbidity.

Pool 19	Gakstatter, J.H. and Morris, R.L. “Limnology of the Iowa Reach	Gakstatter summarized his findings as ‘in general, the Iowa reach of the Mississippi River contains water of excellent quality... the Mississippi waters are relatively low in dissolved materials and nutrients although at times extensive algal population are present’.
Pool 19	Grove, M.A., Anderson, R.V. and Day, D. “The Potential Effects of Expanding Macrophyte Development on Channel Border Benthic Communities: Mississippi River Research Consortium (1982)	Grove et. al. found silt decreasing depth in lower reaches of pool 19, thus increasing size and distribution of aquatic plant beds. Macroinvertebrate community differences were found ‘in relation to plant bed structure with little overlap between the communities’.
Pool 19	LeKander, Bob, FAX “Turbidity Data for Burlington Municipal Waterworks (2001)	Not listed because monthly turbidity average readings low to moderate turbidity.
Pool 19	Lugn, A.L. “Sedimentation in the Mississippi River between Davenport, Iowa and Cairo, Illinois (1927)	Ph.D. dissertation published in 1927. Six types of classes (size & percent) of sediment were identified in the Miss. River between Davenport, IA. and Cairo, Illinois.
Pool 19	Meade, Robert H. “Setting: Geology, Hydrology, Sediments, and Engineering of the Mississippi River (1995)	Not listed because sediment loads have decreased by one-half since settlement by European colonists.
Pool 19	Iowa Hygienic Laboratory “Mississippi River Water Quality Survey Report” (1969)	Not listed because impairment appeared to be caused by point source discharges
Pool 19	U.S. Geological Survey. 1999. “Ecological status and trends of the Upper Mississippi River System 1998”.	Not listed because no consistent long term trend of increasing turbidity. Good sediment quality reported and abundant submerged aquatic vegetation in upper impoundment reaches of pools 4 to 13
Pool 19	Wilson, D.M., Naimo, T.J., Wiener, J.G., Anderson, R.V., Sandheinrich, M.B. and Sparks, R.E. “Declining Populations of the Fingernail Clam Musculium Transversum in the Upper Mississippi River Hydrobiologia (1995)	Not listed because no conclusions were drawn from Pool 14 data

Note: Bolded “Title & Author” entries indicate documents identified in the consent decree for consideration in developing Iowa’s 2002 303(d) list.

Attachment B: Listing of Documents Reviewed by EPA

Consent Decree Documents

(i) Rogala, James T. and Peter J. Boma. 1996. Rates of Sedimentation Along Selected Backwater Transects in Pools 4, 8, and 13 of the Upper Mississippi River. Technical Report 96-T005. U.S. Geological Survey, Environmental Management Technical Center, Onalaska, Wisconsin. October 1996. 24pp.

(ii) U.S. Geological Survey. 1999. Ecological status and trends of the Upper Mississippi River System 1998: A report of the Long Term Resource Monitoring Program. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. April 1999. LTRMP 99-T001. 236pp.

(iii) Aspelmeier, Bill and Mike Griffin. No Date. Sediment Study UMRS. PowerPoint presentation. Iowa Department of Natural Resources. (Note: This is the same item identified in Section III, Consent Decree Commitments as 1.(iii)).

(iv) Bhowmik, Nani G., J. Rodger Adams and Richard E. Sparks. 1993. Fate of Navigation Pool on Mississippi River. Illinois State Water Survey. Long Term Resource Monitoring Program. Reprint 93-R001. Environmental Management Technical Center. Onalaska, Wisconsin. March 1993. 4pp.

(v) Hiebert, T.I., H.F. Bernhard, P.H. Howe, and D.R. Helms. 1982. Sedimentation Rates and Standing Stock Estimates in Selected Sloughs of Pool 14 of the Mississippi River: Mississippi River Research Consortium. 15th Annual Meeting April, 1982. La Crosse, Wisconsin. Abstract.

(vi) Upper Mississippi River Basin Commission. 1982. Comprehensive Master Plan for the Management of the Upper Mississippi River System. Upper Mississippi River Basin Commission, Minneapolis, Minnesota. January 1, 1982. 193pp.

(vii) U.S. Army Corps of Engineers. 1997. Report to Congress - An Evaluation of the Upper Mississippi River System Environmental Management Program. December 1997. U.S. Army Corps of Engineers, Rock Island District.

Additional Documents Reviewed

Canfield, T.J., E.L. Brunson, F.J. Dwyer, C.G. Ingersoll, N.E. Kemble. 1998. Assessing Sediments from Upper Mississippi River Navigational pools using Benthic Invertebrate Community Evaluation and the Sediment Quality Triad Approach. Archives of Environmental Contamination and Toxicology 35:202-212.

Cole, Bill. 2001. FAX: Turbidity data from 1998 to current from Keokuk, IA. Keokuk Municipal Water Works. 7pp.

Gakstatter, J.H. and R.L. Morris. 1970. Limnology of the Iowa Reach of the Mississippi River. State Hygienic Laboratory, University of Iowa, Ames, Iowa. Houston, Texas, October 1970. 14pp.

Galatowitsch, S.M. and T.V. McAdams. 1994. Distribution and Requirements of Plants on the Upper Mississippi River - Literature Review. Iowa Cooperative Fish and Wildlife Research Unit. 175pp.

Gammon, J.R. 1970. The Effect of Inorganic Sediment On Stream Biota. DePauw University, Greencastle, Indiana. U.S. Environmental Protection Agency, Water Pollution Control Series #18050DWC12/70. 141pp.

Gaugush, Robert F. 1997. Sediment Budgets for Two Navigation Pools of the Upper Mississippi River System. U.S. Geological Survey. Upper Mississippi River Long Term Resource Monitoring Program. Project Status Report 97-10. August 1997.

Grove, M.A., R.V. Anderson, and D. Day. 1982. The Potential Effects of Expanding Macrophyte Development on Channel Border Benthic Communities: Mississippi River Research Consortium. 15th Annual Meeting April, 1982. La Crosse, Wisconsin. Abstract.

Gutreuter, S. 1997. Fish monitoring by the Long Term Resource Monitoring Program on the Upper Mississippi River System: 1990 - 1994. U.S. Geological Survey, Environmental Management Technical Center Technical Report 97 - T004. 78pp.

Hart, C.W. and S.L.H. Fuller. 1974a. Clams and Mussels (Mollusca: Bivalvia). In: Pollution Ecology of Freshwater Invertebrates. Academic Press, New York.

Hart, C.W. and S.L.H. Fuller. 1974b. Insects (Arthropoda: Insecta). In: Pollution Ecology of Freshwater Invertebrates. Academic Press, New York.

LeKander, Bob. 2001. FAX: Turbidity data for Burlington Municipal Waterworks. Burlington Municipal waterworks. December 2001. 3pp.

Lugn, A.L. 1927. Sedimentation in the Mississippi River Between Davenport, Iowa and Cairo, Illinois. Ph.D. Dissertation. State University of Iowa Graduate College. 104pp.

MBUR. 2000. Data on CD. MBUR (Mississippi at Burlington) Daily Concentration, Load, and Flow 1967-2000.

Meade, Robert H., 1995. Setting: Geology, Hydrology, Sediments, and Engineering of the Mississippi River. U.S. Geological Survey Circular 1133. Reston, Virginia. 1995.

Necombe, C.P. and D.D. MacDonald. 1991. Effects of Suspended Sediments on Aquatic Ecosystems. North American Journal of Fisheries Management. 11:72-82.

Rogala, James T. 1997. Rates of Net Fine Sediment Accumulation in Selected Backwater Types of Pool 8, Upper Mississippi River. Interim Report for the Upper Mississippi River - Illinois Waterway System Navigation Study. Environmental Report 2. U.S. Army Corps of Engineer Districts of Rock Island, St. Louis and St. Paul.

Sauer, J.S. 1998. Temporal Analyses of Select Macroinvertebrates in the Upper Mississippi River System. Long Term Resource Monitoring Program Technical Report 98-T001. U.S. Geological Survey Environmental Management Technical Center. April 1998. 27pp.

Sauer, J.S. 1999. Mayflies (Ephemeroptera) and Fingernail Clams (Sphaeriidae) at Selected Sites in the Upper Mississippi River System. Long Term Resource Monitoring Program, Program Report 99-P001. U.S. Geological Survey Upper Midwest Environmental Sciences Center. February 1999. 19pp.

State Hygienic Laboratory. 1969a. Mississippi River Water Quality Survey Report, Davenport, Iowa Area, River Mile 464 - 493. State Hygienic Laboratory, University of Iowa, Ames, Iowa. 70-7 25pp.

State Hygienic Laboratory. 1969b. Mississippi River Water Quality Survey Report, Ft. Madison, Iowa Area, River Mile 377.3 - 383.3. State Hygienic Laboratory, University of Iowa, Ames, Iowa. 70-6. 23pp.

State Hygienic Laboratory. 1970. Mississippi River Water Quality Survey, Burlington, Iowa, River Miles 397-404. State Hygienic Laboratory, University of Iowa, Ames, Iowa. 70-41. 25pp.

State Hygienic Laboratory. 1971. Mississippi River Water Quality Survey, Dubuque, Iowa. State Hygienic Laboratory, University of Iowa, Ames, Iowa. 72-18. 25pp.

U.S. Army Corps of Engineers. 1999. Upper Mississippi River Navigation and Sedimentation Field Data Collection Summary Report. Interim Report for the Upper Mississippi River - Illinois Waterway System Navigation Study. Environmental Report 6. U.S. Army Corps of Engineer Districts of Rock Island, St. Louis and St. Paul.

U.S. Army Corps of Engineers. 2001. Entrainment and Transport of Sediments by Towboats in the Upper Mississippi River and Illinois Waterway, Numerical Study. Interim Report for the Upper Mississippi River - Illinois Waterway System Navigation Study. Environmental Report 37. U.S. Army of Engineer District of Rock Island, St. Louis, and St. Paul.

U.S. Environmental Protection Agency. 1999. Guidance Manual for Compliance with the Interim Enhanced Surface Water Treatment Rule: Turbidity Provisions. USEPA Office of Water, EPA 815-R-99-010.

U.S. Geological Survey. 2000a. Long Term Resource Monitoring Program Macroinvertebrate Data. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin.

U.S. Geological Survey. 2000a. Long Term Resource Monitoring Program Water Quality Data. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin.

Vohs, P.A., I.J. Moore and J.S. Ramsey. 1993. A critical review of the effects of turbidity on aquatic organisms in large rivers. Report by Iowa State University, Ames, Iowa, for the U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 93-S002. 139pp.

Waters, Thomas. 1995. Sediment in Streams. Source, Biological Effects, and Control. American Fisheries Society Monograph 7. 251pp.

Wiener, James, Richard Anderson and David McConville. 1984. Contaminants in the Upper Mississippi River. Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium. 368pp.

Wilson, D.M., T.J. Naimo, J.G. Wiener, R.V. Anderson, M.B. Sandheinrich, R.E. Sparks. 1995. Declining populations of the fingernail clam *Musculium transversum* in the Upper Mississippi River. Hydrobiologia 304:209-220.